HARD EXCLUSIVE PION PRODUCTION AT HERMES

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The recent growing theoretical interest for hard exclusive processes started since Collins Frankfurt, and Strikman formulated and proved a QCD factorization theorem for the hard exclusive electroproduction of mesons [1]. Indeed, it as been shown that the unknown Skewed Parton Distribution (SPD) functions appearing in this factorization scheme can be related to new parton spin and angular momentum distribution functions and therefore shed new light on the nucleon spin puzzle [2]. First and preliminary results from HERMES on hard exclusive pion production are presented.

Yield and azimuthal asymmetries for exclusive pions

The HERMES spectrometer allow unambiguous charged pions identification in the range 4.5 GeV $< E_\pi <$ 14.0 GeV. Neutral pion identification is provided by the detection of γ-cluster from two-photons π^0 decay, requiring $E_\gamma > 1.0$ GeV and 0.10 GeV $< M_{\gamma\gamma} <$ 0.17 GeV. The final state missing mass M_X and the squared 4-momentum transfered to the nucleon t can be computed from lepton and pion kinematics: $M_X^2 = (P + q - P_\pi)^2$ and $t = (q - P_\pi)^2$, where P is the nucleon target 4-momenta and $q = k - k'$ (see Fig. 1). The missing mass distribution for semi-inclusive π^+ events requiring $Q^2 > 1$ GeV^2,$W^2 > 4$ GeV^2 and $-t < 0.5$ GeV^2 is shown at Fig. 1. Furthermore, the events with more than one pion and one electron track were rejected. Background contributions to the reaction $e\ p \rightarrow e'\ \pi^+\ n$ were estimated from the measured π^- yield. The latter beeing normalised by a factor 1.4, arising from the comparison of π^+ and π^- missing mass spectrum above 2 GeV. A clear peak at missing mass around nucleon mass arise after subtraction of the normalised π^- yield from the π^+ yield. The kinematic of the exclusive events sample is $\langle Q^2 \rangle = 2.4$ GeV^2 and $\langle x \rangle = 0.1$.

Single spin azimuthal asymmetries arising with polarised target and unpolarised beam were evaluated according to $A_{\rm UL}^{\sin\phi} = \frac{1}{P} \frac{\int_0^{2\pi} \sin\phi \ {\rm d}N_+ \ - \ \int_0^{2\pi} \sin\phi \ {\rm d}N_-}{\frac{1}{2}[\int_0^{2\pi} {\rm d}N_+ \ + \ \int_0^{2\pi} {\rm d}N_-]}$ where ϕ is the angle between the hadronic and the leptonic planes (see Fig. 1), P is the target polarization and $\pm$ refer to the target polarization state. Results are reported on Fig. 1. No cuts on t and on the track number were applied. For π^+, a large significant negative asymmetry is observed in the exclusive channel, in contrast to the positive asymmetry measured for semi-inclusive π^+ [3]. A strong rise of the asymmetry toward exclusive region is observed for π^0. For π^-, the asymmetry was found to be compatible with zero over all the kinematic range.

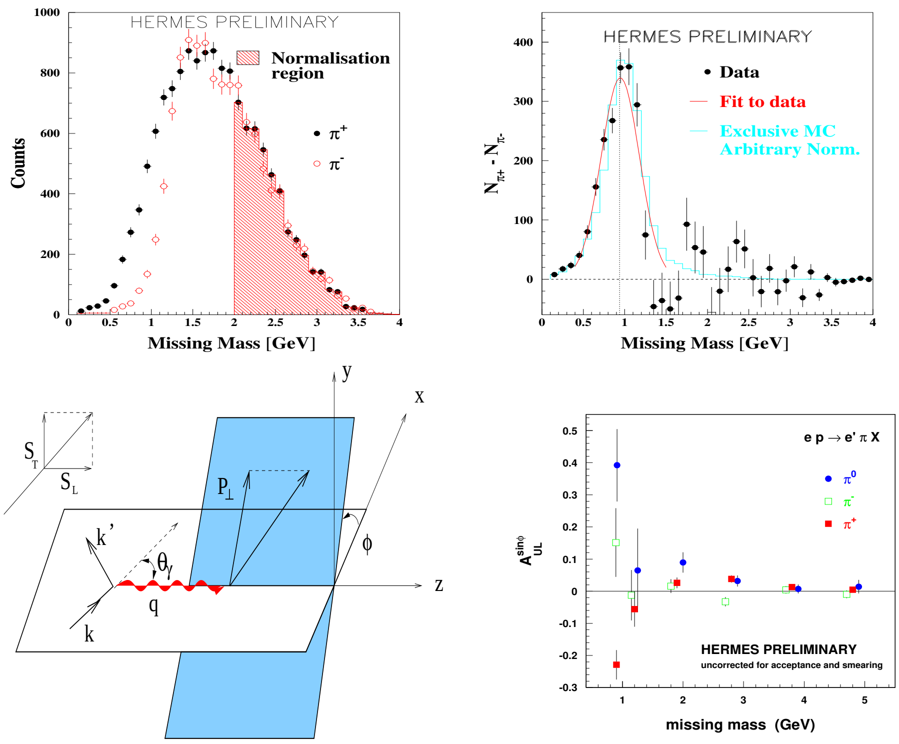

Figure 1: Top: Measured π^+ and normalised π^- yields as function of missing mass (left) and their difference (right). The smooth curve is a Gaussian fit to data and the histogram is from MC simulation. Bottom: kinematic of the reaction and results for $A_{\mathrm{UL}}^{\sin\phi}$ as function of missing mass.

References

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2. X. Ji, *Phys. Rev. Lett.* **78**, 610 (1997).
3. A. Airapetian et al., HERMES coll., *Phys. Rev. Lett.* **84**, 4097 (2000).